

What is claimed is:

1. A liquid crystal display device comprising:
  - a liquid crystal element which includes
    - a front substrate which is arranged at a front side from where a screen is
    - 5 viewed,
    - a back substrate which is arranged at a back of said front substrate so as to be opposed to said front substrate,
    - at least one first electrode which is formed on one of an internal surface of said front substrate and an internal surface of said back substrate, the internal surfaces
    - 10 being opposed to each other,
    - at least one second electrode which is arranged on the other of the internal surfaces opposed to each other so as to be opposed to said at least one first electrode, thereby forming at least one pixel in an area where said at least one first electrode and said at least one second electrode are opposed to each other,
    - 15 a liquid crystal layer which is sandwiched between said front substrate and said back substrate,
    - at least one reflective film which is provided at a back of said liquid crystal layer so as to correspond to a part of said at least one pixel, such that a reflective portion for reflecting an incident light and a transmissive portion which is a region other than said
    - 20 reflective portion and through which an incident light permeates are formed in said at least one pixel,
    - a color filter which is provided on one of the internal surfaces opposed to each other so as to correspond to said at least one pixel, and
    - a liquid crystal layer thickness adjusting layer which is provided on at least a
    - 25 region corresponding to said reflective portion between said front substrate and said back substrate, in order to adjust a thickness of said liquid crystal layer in said reflective portion with respect to a thickness of said liquid crystal layer in said transmissive portion

in accordance with a thickness of said color filter;

a front polarizing plate and a back polarizing plate which are arranged at a front and a back of said liquid crystal element; and

a backlight which is arranged at a back of said back polarizing plate.

5        2.        The liquid crystal display device according to claim 1, wherein

a thickness of said liquid crystal layer thickness adjusting layer is set such that a thickness of said color filter in said reflective portion is thinner than a thickness of said color filter in said transmissive portion, and the thickness of said liquid crystal layer in said reflective portion is thinner than the thickness of said liquid crystal layer in said

10 transmissive portion.

3.        The liquid crystal display device according to claim 1, wherein

a thickness of said liquid crystal layer thickness adjusting layer is set such that a thickness of said color filter in said reflective portion is equal to a thickness of said color filter in said transmissive portion, and the thickness of said liquid crystal layer in said

15 reflective portion is thinner than the thickness of said liquid crystal layer in said transmissive portion.

4.        The liquid crystal display device according to claim 1, wherein

a thickness of said liquid crystal layer thickness adjusting layer is set such that a thickness of said color filter in said reflective portion is thinner than a thickness of said color filter in said transmissive portion, and the thickness of said liquid crystal layer in said reflective portion is equal to the thickness of said liquid crystal layer in said

20 transmissive portion.

5.        The liquid crystal display device according to claim 4, further comprising

a flattening film which formed on said color filter in order to flatten a surface of said

25 color filter having different thicknesses.

6.        The liquid crystal display device according to claim 4, wherein

said liquid crystal element is an STN (Super Twisted Nematic) liquid crystal display

element.

7. The liquid crystal display device according to claim 1, wherein  
said liquid crystal element comprises a homogeneous liquid crystal layer in which  
liquid crystal molecules are oriented substantially in parallel with surfaces of a pair of  
5 substrates without being twisted between the substrates in a non electric field state where  
no electric field is applied.

8. The liquid crystal display device according to claim 1, wherein  
said liquid crystal layer thickness adjusting layer is made of a transparent insulation  
film.

10 9. The liquid crystal display device according to claim 1, wherein  
said color filter has a hole which is formed by removing a part of said color filter, at  
a portion corresponding to said reflective portion of said at least one pixel.

10. The liquid crystal display device according to claim 9, wherein  
said liquid crystal layer thickness adjusting layer fills said hole formed in said color  
15 filter.

11. The liquid crystal display device according to claim 9, wherein  
said liquid crystal layer thickness adjusting layer is formed so as to fill said hole  
formed in said color filter and to cover said color filter.

12. The liquid crystal display device according to claim 1, wherein:  
20 said liquid crystal layer thickness adjusting layer is formed on a surface of one of  
said front substrate and said back substrate; and  
said color filter is formed such that a part of said color filter covers said liquid  
crystal layer thickness adjusting layer.

13. The liquid crystal display device according to claim 1, wherein  
25 said reflective layer has a reflective surface on which depressions and protrusions  
are formed.

14. The liquid crystal display device according to claim 1, wherein:

a value of a product  $\Delta n \cdot d_1$  of a thickness  $d_1$  and a refractive index anisotropy  $\Delta n$  of said liquid crystal layer in said reflective portion is set to a value which makes said liquid crystal layer provide a retardation of  $1/4$  wavelength to a transmitting light in a non electric field state in which substantially no electric field is applied between electrodes  
 5 opposed to each other; and

a value of a product  $\Delta n \cdot d_2$  of a thickness  $d_2$  and a refractive index anisotropy  $\Delta n$  of said liquid crystal layer in said transmissive portion is set to a value that makes said liquid crystal layer provide a retardation of  $1/2$  wavelength to a transmitting light in the non electric field state.

10 15. The liquid crystal display device according to claim 14, further comprising a front retardation plate and a back retardation plate which are respectively arranged between said front polarizing plate and said liquid crystal layer and between said back polarizing plate and said liquid crystal layer such that their slow axes are orthogonal to each other, and which provide a retardation of  $1/4$  wavelength to a transmitting light,  
 15 wherein:

said front polarizing plate and said back polarizing plate are arranged such that their transmission axes are orthogonal to each other;

said front retardation plate is arranged so as to cancel the retardation provided to the transmitting light by said liquid crystal layer in the non electric field state.

20 16. The liquid crystal display device according to claim 15, further comprising a scattering reflective plate which is arranged between said front polarizing plate and said liquid crystal layer and which scatters a transmitting light.

17. A liquid crystal display device comprising:

a liquid crystal element which includes

25 a front substrate which is arranged at a front side from where a screen is viewed,

a back substrate which is arranged at a back of said front substrate so as to be

opposed to said front substrate,

at least one opposite electrode which is formed on an internal surface of said front substrate that is opposed to said back substrate,

a plurality of pixel electrodes which are arranged on an internal surface of  
 5 said back substrate that is opposed to said front substrate so as to be opposed to said at least one opposite electrode, thereby forming a plurality of pixels in areas where said at least one opposite electrode and said plurality of pixel electrodes are opposed to each other,

a liquid crystal layer which is sandwiched between said front substrate and  
 10 said back substrate,

a plurality of reflective films which are provided on the internal surface of said back substrate so as to respectively correspond to parts of said plurality of pixels, such that a reflective portion for reflecting an incident light and a transmissive portion which is a region other than said reflective portion and through which an incident light  
 15 permeates are formed in each of said plurality of pixels,

a color filter which is provided on the internal surface of said front substrate that is opposed to said back substrate, so as to correspond to said plurality of pixels, and

liquid crystal layer thickness adjusting layers which are provided on regions corresponding to at least said reflective portions on said color filter formed on the internal  
 20 surface of said front substrate that is opposed to said back substrate, in order to make a thickness of said liquid crystal layer in said reflective portions thinner than a thickness of said liquid crystal layer in said transmissive portions;

a front polarizing plate and a back polarizing plate which are arranged at a front and a back of said liquid crystal element; and

25 a backlight which arranged at a back of said back polarizing plate.

18. The liquid crystal display device according to claim 17, wherein:

thicknesses of said respective liquid crystal layer thickness adjusting layers are set

such that a thickness of said color filter in said reflective portions is equal to a thickness of said color filter in said transmissive portions, and the thickness of said liquid crystal layer in said reflective portions is thinner than the thickness of said liquid crystal layer in said transmissive portion;

- 5        said color filter has holes formed by removing parts of said color filter, at portions corresponding to said reflective portions of said plurality of pixels; and
- said liquid crystal layer thickness adjusting layers are formed so as to fill said holes formed in said color filter and to cover said color filter.

19.    A liquid crystal display device comprising:

- 10       a liquid crystal element which includes
- a front substrate which is arranged at a front side from where a screen is viewed,
- a back substrate which is provided at a back of said front substrate so as to be opposed to said front substrate,
- 15       at least one opposite electrode which is formed on an internal surface of said front substrate that is opposed to said back substrate,
- a plurality of pixel electrodes which are arranged on an internal surface of said back substrate that is opposed to said front substrate so as to be opposed to said at least one opposite electrode, thereby forming a plurality of pixels in areas where said at
- 20       least one opposite electrode and said plurality of pixel electrodes are opposed to each other,
- a liquid crystal layer which is sandwiched between said front substrate and said back substrate,
- a plurality of reflective films which are provided on the internal surface of
- 25       said back substrate so as to respectively correspond to parts of said plurality of pixels, such that a reflective portion for reflecting an incident light and a transmissive portion which is a region other than said reflective portion and through which an incident light

permeates are formed in each of said plurality of pixels,

a liquid crystal layer thickness adjusting layer which is provided on the internal surface of said front substrate that is opposed to said back substrate so as to correspond to at least said reflective portions of said plurality of pixels, in order to make a thickness of said liquid crystal layer in said reflective portions thinner than a thickness of said liquid crystal layer in said transmissive portions, and

a color filter which covers said liquid crystal layer thickness adjusting layer on the internal surface of said front substrate that is opposed to said back substrate, and which is provided so as to correspond to said plurality of pixels;

10 a front polarizing plate and a back polarizing plate which are arranged at a front and a back of said liquid crystal element; and

a backlight which is arranged at a back of said back polarizing plate.

20. The liquid crystal display device according to claim 19, wherein

a thickness of said color filter in said reflective portions is thinner than a thickness of said color filter in said transmissive portions;

a thickness of said liquid crystal layer thickness adjusting layer is set such that the thickness of said liquid crystal layer in said reflective portions is thinner than the thickness of said liquid crystal layer in said transmissive portions; and

said color filter has holes formed by removing parts of said color filter, at portions corresponding to said reflective portions.